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eye and the prism till its wires reached the limit of separate visibility. The intensity of the light was made so great that no increase of intensity caused an increase in the visibility of the wires. Wave lengths 670, 605, 575, 535, 505, 470, 430 $\mu\mu$, corresponding to the seven spectral colors were used. The experiments show that the *color* of the light has scarcely any influence provided that the *intensity* is sufficient. The limit was reached for one observer when a wire subtended an angle of about 32."8, for the other 27."6, corresponding respectively to retinal images of 0.00234 mm., and 0.002 mm. The value generally assigned for this angle is 1' and these experiments, when the measurement is made in the same way, i. e. from the middle of one wire to the middle of the next, give substantially the same result, namely: for one observer 65."6, for the other 55."2.

Ueber die Muskuläre Reaction und die Aufmerksamkeit. GÖTZ MARTIUS. Philos. Stud. Bd. VI, H. 2.

The question here discussed is the significance of the important distinction between "sensory" and "motor" forms of reaction as introduced by Lange. The distinction itself Martius fully corroborates, finding it somewhat small in practiced reactors (about 20 σ), but marked in two novices (about 100 σ .) He, however, agrees with Wundt that the distinction is confined to simple reactions, and questions the validity of Münsterberg's extension of this distinction to more complicated reactions. He has repeated Münsterberg's experiments of reacting with the five and with the ten fingers to the first five and first ten numbers, the reaction to five vocal sounds, to five different declensional forms, to five categories such as a "river," "a city," etc., and finds in all these cases where Münsterberg found a large and increasing difference between the "sensory" and "motor" reactions, only a slight difference; and while Münsterberg finds the "sensory" longer than the "motor," Martius has a flatly contradictory result. While unable to explain Münsterberg's results, he feels confident that no true distinction between motor and sensory was there involved, and that it is impossible to apply this distinction beyond the simple reaction. The second portion of the study describes simple reactions in which the subject, after each reaction, gave a judgment as to its comparative worth, and also described his attitude of mind at the moment of reacting. This very commendable method is not carried forth with sufficient system to allow of easy formulatable conclusions, but they leave in Martius's mind an increased confidence in the value of his results. A third point discussed at length is the mechanism by which the shortening process of the motor reaction takes place. In opposition to the view that it is a return to a reflex mode of action—a view which he treats too literally—he holds that the motor reaction anticipates and takes for granted the precise nature of the stimulus and therefore reacts to it at an earlier stage of its development.

The most essential and puzzling contribution of this paper is the opposition to Münsterberg's results; only careful and abundant research can explain this important point.

J. J.

Untersuchungen zur Mechanik der activen Aufmerksamkeit. GEORG DWELSHAUVERS. Philos. Stud. Bd. VI, H. 2.

The author has determined anew the effect of a signal preceding the stimulus in reactions, with due reference to the distinction between "sensory" and "motor" reactions. He finds that reactions to the fall of a hammer preceded by a signal at an interval of 1½ seconds, were executed in 257 σ sensory and 130 σ motor; if the interval was 3 seconds, the times were 280 σ and 133 σ ; if 6 seconds, 300 σ and 149 σ , (average of 5 subjects). On the other hand, when no signal preceded, the "sensory"

time was 305 σ and the "motor" 188 σ . In all these results the attention was closely focused upon the reaction. If the attention were purposely diverted from the reactions and no signal preceded, the time was 353 σ . The chief result is thus a corroboration of the distinction between "motor" and "sensory" as well as of the effect of a preceding signal, with accurate determination of the effect of the interval between signal and stimulus upon the reaction-time; it is also shown that the advantage of the signal is greater with "sensory" than with "motor" reactions. The second portion of the research is devoted to the same problem with which Martius (see above) has occupied himself, *i. e.*, the correlation of the subject's own version of the value of his reaction and the state of his attention at the time of reaction. He finds that a complete attention takes place in 85 per cent. of all cases, and that total inattention is rare, and ventures the generalization that as the accuracy of the attention increases the time decreases. The subjective testimony would also indicate that the distinction between "sensory" and "motor" is only a relative one, transitional forms and times appearing everywhere. One's own opinion as to the quickness of the reaction, Dwelshauvers does not value as highly as Martius, but regards it as very liable to effects of contrast and other illusions of judgment. J. J.

Mental Tests and Measurements. J. MCK. CATTELL. *Mind*, XV, 373; July, 1890.

Prof. Cattell here presents in detail the plan for psychic tests mentioned in his note upon Psychology at the University of Pennsylvania in the last number of this JOURNAL. These are: 1, Dynamometer pressure; 2, Rate of movement; 3, Sensation-areas; 4, Pressure causing pain; 5, Least noticeable difference in weight; 6, Reaction-time for sound; 7, Time for naming colours; 8, Bi-section of a 50 cm. line; 9, Judgment of 10 seconds time; 10, Number of letters remembered on once hearing. Numbers 2 and 4 have not so far been much tried, but are promising; new instruments have been devised for making them. These ten tests are now taken at Prof. Cattell's laboratory upon all that are willing, and his students are submitted to a much longer series, a list of which is also here given. Discussion and co-operation is invited (and some notes by Galton are appended to this article) to the end of securing the best methods and uniformity in using them. This move is in the right direction; some standard series of mental measurements is a thing very much to be desired, and uniformity is no less important. Prof. Cattell has upon the stocks a laboratory manual of psychology, a book much needed at this stage of the teaching of experimental psychology.

Ueber die Wahrnehmung und Lokalisation von Schwebungen und Differenz-tönen. KARL L. SCHAEFER. *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*. Bd. I, H. 2. 1890.

That the ear has a certain power of judging the direction and distance of sounds, no one will deny, but how will it locate those that actually have not a single source, that arise from the combination of two other sounds? The most readily audible of such sounds, "beats" (due to interference) and difference-tones, (due to the mechanism of the ear) have been examined in this particular by Schaefer. His experiments were made with tuning forks and lead to the following results. Beats: When the beating tones are of unequal intensity the stronger of the two fixes the apparent place of the beats; when they are of equal intensity the beats are referred to the intermediate space—thus, as a special case, when one tone reaches one ear only and the other tone the other ear only, the location of the beats is in the median plane or even in the middle of the head. Difference-tones: When the generating tones are